Mortality Related to Sexually Transmitted Diseases in US Women, 1973 through 1992

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ABSTRACT

Objectives. This study estimated the trends in mortality related to sexually transmitted diseases (STDs) and their sequelae in US women from 1973 through 1992.

Methods. The total number of deaths was obtained from US national mortality data and from AIDS surveillance data, and current literature was reviewed to estimate proportions of diseases attributable to sexual transmission.

Results. From 1973 through 1984, total STD-related deaths decreased 24%. However, from 1985 through 1992, STD-related deaths increased by 31%, primarily because of increasing numbers of deaths from sexually transmitted human immunodeficiency virus (HIV) infection. The most important changes during the 20-year period were the emergence of and continued increase in the number of deaths related to heterosexually transmitted HIV.

Conclusions. The leading causes of STD-related mortality in women, viral STDs and their sequelae, are generally not recognized as being sexually transmitted. Increases in STD-related mortality are primarily due to sexually transmitted HIV, which will soon surpass cervical cancer as the leading cause. (*Am J Public Health.* 1997;87:938–944)

Introduction

Unprotected sexual contact is well recognized as being associated with risk for subsequent disease. Each year, more than 12 million people in the United States are newly infected with a sexually transmitted disease (STD),[1] excluding hepatitis. What is often not recognized is that substantial morbidity and mortality are related to some sequelae of STDs. This is particularly true for women. Pelvic inflammatory disease, ectopic pregnancy, and cervical cancer are sequelae unique to women that add disproportionately to female mortality. Another consideration that may be overlooked is that deaths from such sequelae of STDs as pelvic inflammatory disease, ectopic pregnancy, cervical cancer, and liver diseases are usually temporally far removed from STD acquisition, thereby making the connection less obvious.

To our knowledge, the first attempt to focus attention on STD-associated mortality in women was an analysis by Grimes, who studied the years 1955, 1965, and 1975, expanding the concept of reproductive mortality to include deaths related to STDs.[2,3] STDs caused 32% of reproductive mortality in 1965 and 20% in 1975.[2] However, it was emphasized that if cervical cancer were considered a sequela of STDs, then deaths due to cervical cancer alone would outnumber deaths due to all other reproductive causes combined. In a summary of published reports on factors contributing to deaths in the United States,[4] sexual behavior was identified as one of the most rapidly increasing causes of mortality, contributing to 30 000 deaths in 1990.

The recognition of cervical cancer as being related to STDs and sexual behavior,[5–10] the emergence of sexually transmitted cases of the human immunodeficiency virus (HIV),[11] recognition of *Chlamydia trachomatis* as an STD and improvements in diagnostic tests for chlamydia, and better understanding of the transmission dynamics of[12–19] and morbidity[19–27] caused by the hepatitis B virus and the hepatitis C virus have expanded the spectrum of STDs and deaths attributable to STDs.

A simple comprehensive approach for identifying morbidity or mortality attributable to all STDs is not available. The current scheme for the classification of diseases (the *International Classification of Diseases* [ICD]) on which vital statistics data are gathered can assess mortality from specific infectious diseases (e.g., cholera) or from the primary pathophysiological conditions identified at the time of death (e.g., liver cancer); however, it cannot assess mortality resulting from a group of diseases such as STDs. Recent attempts to assess mortality for diseases as a group (e.g., infectious diseases[28,29]) or diseases attributable to major external factors (e.g., behavior[4]) have recognized the problems associated with the use of ICD codes and vital statistics data. STDs are infectious diseases, but they are also implicated in several chronic diseases, the causes of which are multifactorial. Therefore, an additional challenge is sorting out the relative contributions of sexual transmission for some agents and the proportion of sequelae caused by those agents.

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For this report, we developed a method for evaluating the burden of STD-related mortality using ICD codes for specific STDs ("hard data") and for diseases or syndromes that can be caused by STDs ("soft data"). We present a composite approximation of deaths attributable to STDs in women in the United States from 1973 through 1992, including all currently recognized STDs and their sequelae, based on actual vital statistics data and the best available estimates on transmission patterns.

Methods

We looked for causes of death that may be due to sexually transmitted infections. We used three different approaches to calculate the total number of deaths: (1) actual number of deaths from diseases that are always sexually transmitted, (2) best estimates of deaths for diseases or syndromes that are not always transmitted sexually, and, (3) for the acquired immunodeficiency syndrome (AIDS), reported deaths of women with sexually transmitted HIV.

We obtained information on deaths related to STDs, except for AIDS, from the Multiple Cause-of-Death public use tapes prepared by the National Center for Health Statistics.[30] Data covered the period January 1, 1973, through December 31, 1992 (1992 was the most recent year for which final data were available). We obtained the number of deaths of all women 15 years of age or older who were US residents. These tapes include information from all death certificates filed in the United States.[30]

All causes of death (except for AIDS) were grouped by means of the eighth revision of the ICD (adapted for use in the United States)[31] for the years 1973 through 1978 and the ninth revision[32] for the years 1979 through 1992. The ICD codes for specific STDs and other diseases and syndromes used in this analysis appear in Table 1.

We obtained information on the total number of deaths from syphilis, gonorrhea, and "other venereal diseases" (diseases included in this category are shown in Table 1). We also obtained information on the total number of deaths attributable to cervical cancer, pelvic inflammatory disease, ectopic pregnancy, viral hepatitis, chronic liver disease (excluding primary biliary cirrhosis), and hepatoma. We did not assess deaths attributable to *C trachomatis* separately because no code was assigned for *C trachomatis* in the eighth revision of the ICD.

TABLE 1—*International Classification of Diseases* (ICD) Codes Used to Identify Sexually Transmitted Diseases and Related Conditions

Disease	ICD-8 (1973 through 1978)	ICD-9 (1979 through 1992)
Syphilis	090–097	090–097
Gonococcal infections	098	098
Pelvic inflammatory disease	612–614, 616.0	614–616[a,b]
Ectopic pregnancy	631	633[b]
Viral hepatitis	070 (infectious hepatitis)	070 (viral hepatitis)
Chronic liver disease	571 (cirrhosis of liver)	571 (chronic liver disease and cirrhosis)
Hepatoma	155.0	155.0
Cervical cancer	180	180
Other venereal diseases	099 (099.0, chancroid; 099.1, lymphogranuloma venereum; 099.2, granuloma inguinale; 099.9, other and unspecified)	099[a] (099.0, chancroid; 099.1, lymphogranuloma venereum; 099.2, granuloma inguinale; 099.3, Reiter's disease[c]; 099.4, other nongonococcal urethritis[d]; 099.5, other venereal diseases due to *Chlamydia trachomatis*[d]; 099.8, other venereal diseases[e]; 099.9, venereal diseases unspecified[e])

Note. The actual terminology used in the ICD is listed in parentheses when it changed between the two versions. The eighth revision was adapted for use in the United States.
[a]Codes expanded to allow subgroup specifications.
[b]Code numbers changed.
[c]Presumably included in 098.3 in the eighth revision.
[d]Not specified in the eighth revision, presumably coded as "other and unspecified" (099.9).
[e]Coded in the eighth revision as 099.9.

We assumed that syphilis, gonorrhea, and "other venereal diseases" were always caused by a sexually transmitted infectious agent. We also made the possibly controversial assumption that all cervical cancers were caused by sexually transmitted agents. The current literature substantiates the theory that human papilloma virus is a necessary factor for the development of cervical intraepithelial neoplasia,[5–7] although other cofactors, including sexual behavior and reproductive risk factors,[8,9] may also influence the development of cervical cancer. The Consensus Development Conference Statement on cervical cancer concurs that cervical cancer is virally induced in essentially every case.[10]

For ectopic pregnancy, pelvic inflammatory disease, and diseases related to hepatitis B virus and hepatitis C virus, we used information from the literature to estimate how often the cause was an infectious agent and how often those agents were sexually transmitted.

For pelvic inflammatory disease, we assumed that 65% of cases were caused by sexually transmitted infections, based on a recent US study of 1667 patients.[33] In the United States, the reported proportion of pelvic inflammatory disease attributable to STDs has been as high as 90%[33–35] in selected populations, but the frequently reported range has been 40% to 80%. Using this latter range, we also calculated upper and lower estimates of STD-related pelvic inflammatory disease.

We used 43% as a conservative estimate of ectopic pregnancies attributable to infections that were sexually transmitted, based on a study of 264 patients.[36] Research on the proportion of ectopic pregnancies attributable to STDs in the United States has been limited. Four case–control studies conducted in the United States[36–39] have produced estimates of 43% to 72%. Accordingly, we used the 72% estimate to calculate the upper estimate of STD-related mortality from ectopic pregnancy.

For viral hepatitis, chronic liver diseases, and hepatoma, we first determined how often they were caused by hepatitis B or hepatitis C virus. We then

TABLE 2—Sexually Transmitted Disease–Related Deaths in Women: United States, 1973 through 1992

Year	Cervical Cancer	Hepatitis B and Hepatitis C	HIV	Syphilis	Pelvic Inflammatory Disease	Ectopic Pregnancy	Gonorrhea	Other Venereal Diseases	All Causes
1973	6 980	1 003	0	370	323	23	7	7	8 713
1974	6 862	966	0	328	262	23	2	7	8 450
1975	6 524	943	0	263	263	24	4	10	8 031
1976	6 432	931	0	297	270	19	4	3	7 956
1977	6 124	908	0	233	246	22	3	6	7 542
1978	6 009	896	0	207	211	19	16	4	7 362
1979	5 696	925	0	231	331	23	4	4	7 214
1980	5 648	939	0	228	309	24	5	3	7 156
1981	5 548	891	0	211	308	11	1	1	6 971
1982	5 313	883	4	182	283	21	1	4	6 691
1983	5 360	900	15	187	272	16	4	4	6 758
1984	5 269	882	49	121	263	19	1	6	6 610
1985	5 198	993	121	117	291	15	2	5	6 742
1986	5 216	878	292	125	276	18	8	4	6 817
1987	5 075	918	494	117	270	15	6	7	6 902
1988	5 125	901	867	110	248	20	2	5	7 278
1989	5 115	951	1 163	117	224	16	5	3	7 594
1990	5 245	964	1 552	135	220	18	2	6	8 142
1991	5 120	978	2 082	119	204	16	4	6	8 529
1992	5 210	960	2 665	99	220	18	3	4	9 179
Total	113 069	18 610	9 304	3 797	5 294	380	84	99	150 637

determined how often the hepatitis B and hepatitis C viruses were sexually transmitted. Using this approach, we calculated, from the total number of deaths due to viral hepatitis, chronic liver diseases (excluding biliary cirrhosis), and hepatoma, an estimate of the proportion of deaths attributable to sexually transmitted hepatitis B and hepatitis C viruses. Finally, because the estimated proportion of hepatitis B virus has a wide range, we also calculated a lower and an upper estimate of deaths related to heterosexually acquired hepatitis B virus.

It has been reported that, of the cases of acute viral hepatitis identified in the United States, hepatitis B accounted for 43% and hepatitis C accounted for 21%.[19] For chronic liver disease (excluding primary biliary cirrhosis), we assumed that 11% of cases were attributable to hepatitis B alone and that 26% were attributable to hepatitis C alone, based on a population-based surveillance study in Alabama.[24] This estimate excludes the proportion of chronic liver diseases related to hepatitis virus and alcohol use combined. For hepatoma, we estimated that 32% of cases were caused by hepatitis B virus and 15% by hepatitis C virus, based on a population study that attributed 47% of hepatomas to prior hepatitis B and hepatitis C virus in fection.[25] The reported rates of hepatoma related to hepatitis B and hepatitis C viruses in the United States are considerably lower[20] than those in many other countries.[21,22]

We estimated that 26% of hepatitis B virus cases in adults were sexually transmitted.[14] Estimates of the proportion of hepatitis B virus infection attributable to sexual transmission in the United States have ranged from 22% to 37%,[12–16] although one estimate among female adolescents was 50%.[13] We estimated that 9% of hepatitis C virus is sexually transmitted. Heterosexual contact (6% to 7.1%) and household contact (2% to 3.4%) have been implicated in hepatitis C virus transmission[15–17]; however, recent data suggest that as much as 60% of household contact transmission occurs via sexual contact.[27] We combined these two fractions to derive our estimate.

The distribution of deaths of women from sexually transmitted HIV was obtained from national AIDS surveillance data (R. M. Selik, written communication, June 1995) maintained through the Division of HIV/AIDS of the Centers for Disease Control and Prevention.[40] For 9% of AIDS-related deaths, there were no identified risk factors for HIV transmission. Some persons with no identified risk factor may have acquired HIV infection through sexual contact; they would not be counted in our analysis. The AIDS surveillance data represent a compilation of all reported AIDS cases in the United States using a uniform surveillance case definition.[40] The surveillance case definition was revised in 1985, 1987, and 1993 to incorporate a broader range of AIDS indicator diseases and laboratory components to improve the sensitivity and specificity of the definition.

Results

During the 20-year period beginning in 1972, we estimate that 150 637 deaths in US women 15 years of age or older were attributable to STDs (Table 2). From 1973 through 1984, the annual number of deaths related to all STDs declined from 8713 to 6610, a decrease of 24% in 12 years. However, from 1984 to 1992, the annual number of STD-related deaths increased by 31% to 9179 (Figure 1).

The trends in the leading causes and proportion of deaths due to each STD changed over time. In 1973, the leading causes were cervical carcinoma (80%), hepatitis B and hepatitis C viruses (11.5%), and syphilis (4%) (Table 2). Other causes of mortality in 1973 were pelvic inflammatory disease (3.7%), ectopic pregnancy (0.26%), and gonococcal infection and "other venereal diseases" (0.08% each). Cervical cancer remained the leading cause of STD-related mortality throughout the study interval. Deaths from hepatitis B and hepatitis C viruses, the second leading cause of STD-related mortality, were exceeded by HIV deaths in 1989. Pelvic inflammatory disease had replaced syphilis as the third leading cause of death by 1977 and remained so until 1986. Deaths related to hepatitis B

and hepatitis C viruses remained the third leading cause of STD-related mortality from 1989 onward. In 1992, the three leading causes of STD-related mortality were cervical carcinoma (57%), HIV (29%), and hepatitis B and hepatitis C viruses (10.5%).

In assessing specific causes of STD-related mortality, we discerned several trends during the 20-year interval (Figures 1 and 2). Deaths from cervical cancer decreased by 25%, deaths from syphilis decreased by 73%, and deaths from sexually transmitted pelvic inflammatory disease decreased by 31%. The most notable change in STD-related mortality in these 2 decades has been the onset of and subsequent increase in heterosexually transmitted HIV-associated mortality. HIV-related deaths were first reported in 1984 and had increased to 29% (n = 2665) of all STD-related deaths by 1992. Deaths related to ectopic pregnancy and to hepatitis B and hepatitis C viruses remained stable. Deaths due to gonococcal infections and other venereal diseases also remained stable over the study interval and contributed very little (<1%) to annual STD-related mortality. Similarly, deaths attributable to STD-related ectopic pregnancy accounted for only 0.2% of total annual STD mortality.

Using the upper and lower estimates that we described for heterosexual transmission of hepatitis B and hepatitis C viruses, the amount of pelvic inflammatory disease attributable to STDs, and the amount of ectopic pregnancy attributable to STD, we found that the total numbers of STD-related deaths during the 20-year period were 146 578 (2.3% lower than our estimate) and 156 596 (3.7% higher), respectively.

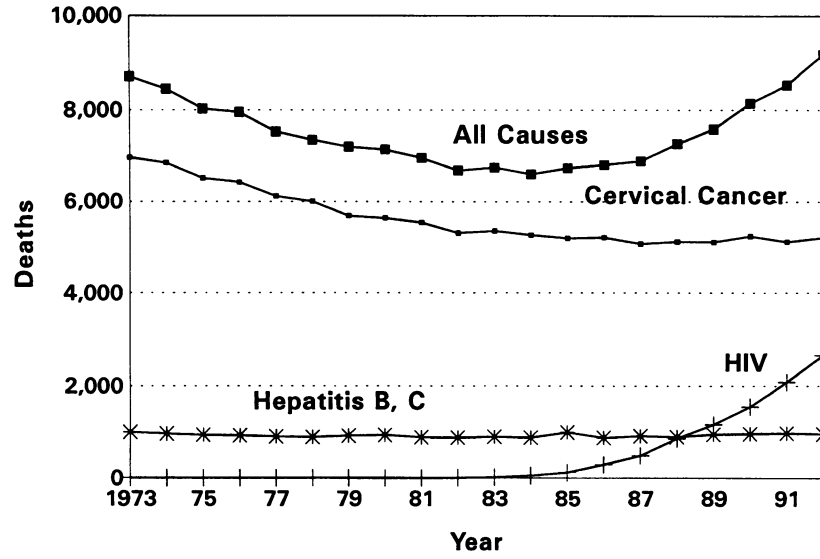

FIGURE 1—STD-related deaths among US women: deaths from all STD-related causes, and deaths attributed to cervical cancer and sexually transmitted HIV, hepatitis B virus, and hepatitis C virus, 1973 through 1992.

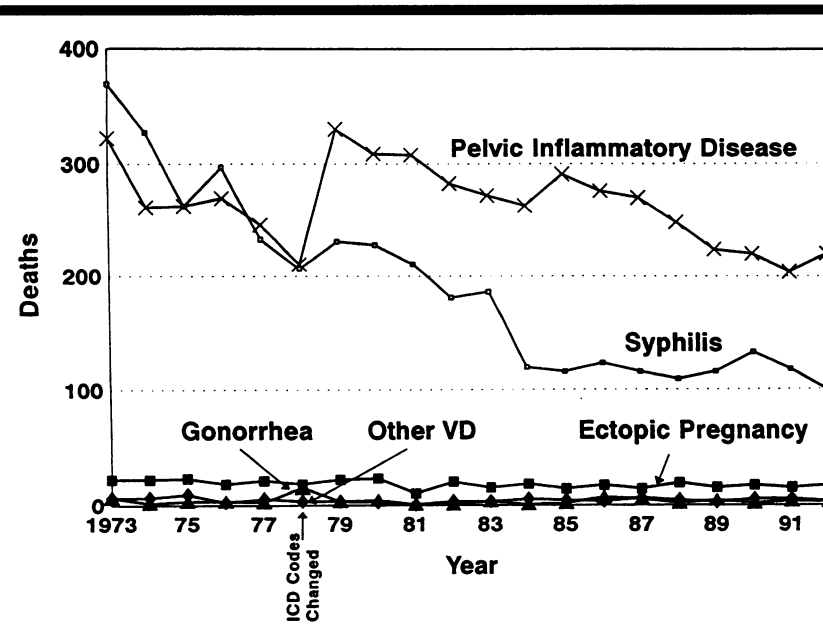

FIGURE 2—Deaths among US women attributed to sexually transmitted pelvic inflammatory disease, syphilis, ectopic pregnancy, gonorrhea, and other venereal diseases, 1973 through 1992.

Discussion

STDs and their sequelae are well recognized as common causes of morbidity among women in the United States, but the fact that these diseases can cause death has received less notice. Information about mortality related to STDs is usually presented one disease at a time or as total mortality from sequelae such as pelvic inflammatory disease, not all of which may be due to an STD. This inexplicit way of labeling STD-related mortality fragments the overall view of STDs by obscuring their aggregate impact. Our analysis, based on actual numbers and on best estimates, indicates that STDs have continued to contribute to a considerable number of deaths in US women over the past 20 years. Furthermore, because of the rapid increase in rates of heterosexual transmission of HIV, STD-related mortality will continue to be among the 10 leading causes of mortality in US women of all ages in the future, even if mortality from all other causes remains stable.

The trend of a general decline in the total number of STD-related deaths of women that was observed in the mid-1980s was reversed by the emergence of HIV infection (Figure 1). The total number of STD-related deaths in 1992 was higher than in any previous year during the study interval. If only non-HIV-

related STD mortality had been considered, the trend of a general decline in STD-related mortality would have continued beyond the mid-1980s.

Currently, viral STDs and their sequelae are the leading causes of STD-related deaths of women 15 years of age or older. Cervical cancer remained the No. 1 cause of death throughout the study interval. A modest decline in the number of cervical cancer deaths occurred over the 20-year study interval. This trend is disappointing because, for cervical cancer, there is a long incubation period and an effective screening tool, the Papanicolaou (Pap) smear, that is inexpensive and widely available, offering opportunities for intervention. In Iceland, cervical cancer mortality has decreased by 80%, a reduction mostly attributable to the organized screening program.[41] Missed opportunities for Pap testing in the United States are evident; during this study interval we found that 37% of women who died from cervical cancer had never had a Pap smear,[42] and nearly one half of poor Black women who were 45 to 64 years of age and lived in nonmetropolitan areas reported never having had a Pap smear.[43]

HIV/AIDS has emerged as an important cause of mortality in US women,[11] and, since 1992, AIDS cases in women related to sexual transmission have exceeded cases related to all other factors, including injection drug use. In addition, because increases in AIDS mortality lag behind increases in HIV incidence, mortality due to HIV infection in women will undoubtedly rise in the coming years, even if the transmission patterns remain stable. These trends predict that sexually transmitted HIV will surpass cervical carcinoma as the leading cause of STD mortality in women. The overall decline in STD mortality observed over the past 20 years has been overwhelmed by mortality related to sexually transmitted HIV alone. Because women infected with HIV are the major source of infection in infants, the health crisis of heterosexually acquired HIV infection in women is of immense significance, extending beyond women's health.

From 1973 through 1992, the mortality associated with sexually transmitted hepatitis B and hepatitis C viruses remained stable, despite the availability of hepatitis B vaccine. There is no effective vaccine against hepatitis C virus, and use of the hepatitis B virus vaccine may be too recent and too limited to elicit a decline in mortality.[13] Furthermore, many of the infections that led to death during the study interval were acquired before the vaccine became available and before the importance of heterosexual transmission of both hepatitis B virus and hepatitis C virus had been recognized.

There are some limitations in our estimates of the number of deaths attributable to sexually transmitted hepatitis B virus and hepatitis C virus infection. First, the incubation period of chronic liver diseases and hepatoma is very long. Second, the occurrence and progression of chronic liver diseases are influenced by several other factors, including alcoholism, chronic malnutrition, and toxins.[22–24] Third, a substantial proportion of patients with hepatitis B[13] or hepatitis C[18] virus infection do not have an identified risk. Finally, we applied estimates of how frequently hepatitis B and hepatitis C viruses were sexually transmitted and how often they caused hepatitis, chronic liver disease, or hepatoma to all deaths from those diseases. However, transmission patterns may be different in different places and at different periods of time. Therefore, extrapolation based on current rates of disease risk and sexual transmission could lead to either underestimation or overestimation. It is hoped that these preliminary analyses will stimulate a more accurate and generalizable estimate of the contribution of sexual transmission of hepatitis B and hepatitis C viruses and ensuing liver diseases.

There has been a decline in mortality attributable to some of the sequelae of STDs, including pelvic inflammatory disease, but this decline was not noted for ectopic pregnancy. There has been an increase in reported chlamydial infections over the past 10 years,[1] but much of the increase is probably due to improvements in case detection, which will actually be expected to decrease mortality. It is disturbing to note that deaths associated with treatable STDs still occur in the United States, while such cases have been almost completely eradicated in many other developed countries. Underscored is the fact that, even today, between 300 and 500 women die each year from pregnancy complications,[44] and deaths from ectopic pregnancy account for 11% of the maternal mortality figures in the United States.[38]

Despite the increase in the reported number of cases of syphilis[1] in the late 1980s, we observed a decline in syphilis-related deaths over the 20-year period. Deaths due to syphilis usually occur decades after an initial infection, and improvements in syphilis control may not be evident in terms of mortality for many years to come. Thus, mortality may not be a good indicator for tracking the short-term effectiveness of control on trends relevant to prevention of infection. However, the long incubation period suggests opportunities for screening, partner notification, and assurance of treatment for syphilis patients. Although syphilis accounted for only 4% of the total number of STD-related deaths in 1973, it still accounted for the largest percentage decrease among all causes of STD-related mortality.

Our estimates differ from previous attempts to focus attention on STD-related mortality. In the analysis by Grimes,[3] only classic STDs (syphilis, gonorrhea, and "other venereal disease") and pelvic inflammatory disease were considered, and thus STD-related mortality may have been underestimated. We have attempted a more comprehensive estimate of the number of deaths from STDs, and this required a variety of assumptions yielding estimates of varying accuracy. Our estimates of deaths from cervical cancer and HIV include few assumptions and are likely to be quite accurate ("hard data"). Our estimates for hepatitis B virus, hepatitis C virus, pelvic inflammatory disease, and ectopic pregnancy ("soft data") involve more assumptions and have more room for error. McGinnes and Foege[4] used a broader definition of deaths attributable to sexual behavior, including unwanted pregnancies and consequent mortality of the infant and mother and deaths in both men and women. STDs in women also have indirect implications that may contribute to deaths in neonates and infants from conditions such as prematurity, low birthweight, congenital syphilis, and neonatal herpes. Thus, McGinnes and Foege's estimates of mortality related to sexual behavior were higher. Our report may also underestimate STD-related mortality because we have not considered other infections that may be transmitted sexually and that may cause death, such as cytomegalovirus and herpes virus.

The completeness of diagnoses listed on death certificates[45,46] is of particular concern in this analysis. Omissions, underreporting, and misclassification of STDs in death certificates undoubtedly occur. For example, syphilis may not be listed in death certificates for deaths from complications of syphilis such as a ruptured aneurysm. Underreporting may occur also from imprecision in diagnosis of diseases such as pelvic inflammatory disease un-

less an autopsy is performed.[47] We did not adjust our data for underreporting and misclassification in death certificates or for underdiagnosis of some diseases. However, the use of Multiple Cause-of-Death records improves the comprehensiveness of the data relative to use of a single underlying cause of death.[29,48] In most areas of the United States, reporting of AIDS cases is more than 85% complete.[40] The likelihood of identifying HIV-related deaths with AIDS surveillance data has been reported to be higher (67% to 97%) than that associated with vital statistics data (55% to 80%).[49]

We used disparate approaches in arriving at estimates of the contribution of an infection to another disease and generalized our estimates. In fact, these proportions may vary from time to time and in different parts of the country. It may be imprecise to assume that estimates of the proportion of a disease that is sexually transmitted can be applied to estimate the proportion of deaths due to sexual transmission of that disease.

In this report, we have limited our analysis of STD-related mortality to women. The overall STD-related mortality rate may be substantially higher for men than for women, but this will be mostly due to HIV. In 1990, in men 25 to 44 years of age, there were 16 717 deaths due to HIV,[50] which exceeds STD-related mortality in women for that year. However, if mortality due to AIDS were excluded, more than 80% of STD-related female mortality would be due to conditions unique to women.

In summary, despite its approximate and conservative nature, this revised assessment of STD-related mortality provides a more comprehensive picture of the mortality risk associated with STD than has been previously attempted, focusing attention on the otherwise neglected components of STD mortality. The leading causes of STD-related mortality, viral STDs and their sequelae, are not generally recognized as being transmitted sexually. Widespread use of Pap smear screening, hepatitis B vaccine, and screening for treatable infections can reduce STD mortality considerably. Clearly, most deaths due to STDs might be prevented with changes in sexual behavior, including correct and consistent use of condoms. □

Acknowledgments

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References

1. *Annual Report, Division of STD/HIV Prevention.* Atlanta, Ga: Centers for Disease Control and Prevention; 1992:29.
2. Sachs B, Layde PM, Rubin GL, Rochat RW. Reproductive mortality in the United States. *JAMA.* 1982;247:2789–2792.
3. Grimes DA. Deaths due to sexually transmitted diseases, the forgotten component of reproductive mortality. *JAMA.* 1986;255: 1727–1729.
4. McGinnes JM, Foege WH. Actual causes of death in the United States, review. *JAMA.* 1993;270:2207–2212.
5. Schiffman MH, Baur HM, Hoover RN, et al. Epidemiologic evidence showing that human papilloma virus infection causes most cervical intraepithelial neoplasia. *JNCI.* 1993;85:958–964.
6. Koutsky LA, Holmes KK, Critchlow CW, et al. A short cohort study of the risk of cervical intraepithelial neoplasia grade 2 or 3 in relation to papilloma virus infection. *N Engl J Med.* 1992;327:1272–1278.
7. Reeves WC, Rawls WE, Brinton LA. Epidemiology of genital papilloma viruses and cervical cancer. *Rev Infect Dis.* 1989;2: 426–439.
8. Brinton LA, Hamman RF, Huggins GR, et al. Sexual and reproductive risk factors for invasive squamous cell cervical cancer. *JNCI.* 1987;79:23–30.
9. La Vecchia CL, Franceschi S, Decarli A, et al. Sexual factors, venereal diseases, and the risk of intraepithelial and invasive cervical neoplasia. *Cancer.* 1986;58:935–941.
10. *Consensus Development Conference Statement, Cervical Cancer.* Bethesda, Md: National Institutes of Health; 1996.
11. Chu SY, Buehler JW, Berkelman RL. Impact of the human immunodeficiency virus epidemic on mortality in women of reproductive age, United States. *JAMA.* 1990;264:225–229.
12. Alter AJ, Margolis HS. The emergence of hepatitis B as a sexually transmitted disease. *Med Clin North Am.* 1990;74: 1529–1540.
13. Alter MJ, Hadler SC, Margolis HS, et al. The changing epidemiology of hepatitis B in the US: need for alternative vaccination strategies. *JAMA.* 1990;263:1218–1222.
14. Margolis S, Alter MJ, Hadler SC. Hepatitis B: evolving epidemiology and implications for control. *Semin Liver Dis.* 1991;11:84–92.
15. Alter MJ, Coleman PJ, Alexander WJ, et al. Importance of heterosexual activity in the transmission of hepatitis B and non-A, non-B hepatitis. *JAMA.* 1989;262:1201–1205.
16. Hess G, Massing A, Rossol S, et al. Hepatitis C virus and sexual transmission. *Lancet.* 1989;2:987.
17. Alter MJ, Hadler SC, Judson NF, et al. Risk factors for acute non-A, non-B hepatitis in the United States and association with hepatitis C virus infection. *JAMA.* 1990; 264:2231–2235.
18. Alter MJ. The detection, transmission, and outcome of hepatitis C virus infection. *Infect Agents Dis.* 1993;2:155–166.
19. Alter AJ, Mast EE. The epidemiology of viral hepatitis in the United States. *Gastroenterol Clin North Am.* 1994;23:437–455.
20. Johnson PJ, Williams R. Hepatitis C antibodies and hepatocellular carcinoma: new clues or a false trail? *JNCI.* 1990;82: 986–987. Editorial.
21. Kaklamani E, Trichopoulos D, Tzonou A, et al. Hepatitis B and C viruses and their interaction in the origin of hepatocellular carcinoma. *JAMA.* 1991;265:1974–1976.
22. Goeser T, Muller HM, Solbach C, et al. Hepatitis C virus, alcoholic cirrhosis, and hepatocellular carcinoma. *Can Epidemiol Biomed Prev.* 1994;3:311–315.
23. Beaseley RP. Hepatitis B virus, the major etiology of hepatocellular carcinoma. *Cancer.* 1988;61:1942–1956.
24. Neal JJ, Margolis SC, Hadler MJ, Alter JA. Viral hepatitis as the leading cause of chronic liver disease in the United States: a population based study. In: *International Symposium on Viral Hepatitis and Liver Diseases, 8th Triennial Congress.* May 1993, Tokyo, Japan. Abstract 750.
25. Yu MC, Tong MJ, Coursaget P, et al. Prevalence of hepatitis B and C viral markers in black and white patients with hepatocellular carcinoma in the US. *JNCI.* 1990;82:1038–1041.
26. DiBisceglie AM, Order SE, Klien JL, et al. The role of chronic viral hepatitis in hepatocellular carcinoma in the United States. *Am J Gastroenterol.* 1991;86:335–338.
27. *Hepatitis Surveillance.* Atlanta, Ga: Centers for Disease Control and Prevention; 1994;55:31.
28. Bennet W, Holmberg SD, Rogers MF, Solomon SL. Infectious and parasitic diseases. In: Amler RW, Dull HB, eds. *Closing the Gap: The Burden of Unnecessary Illness.* New York, NY: Oxford University Press; 1987:102–114.
29. Pinner RW, Teutsch SM, Somonsen L, et al. Trends in infectious diseases mortality in the United States. *JAMA.* 1996;275:189–193.
30. *Vital Statistics Mortality Data, Multiple Cause Detail, 1969–1992.* Hyattsville, Md: National Center for Health Statistics; 1992.
31. *Eighth Revision, International Classification of Diseases.* Washington, DC: US Dept of Health, Education and Welfare; 1968. Publication PHS 1693.
32. *International Classification of Diseases. Ninth Revision.* Geneva, Switzerland: World Health Organization; 1977.
33. Jossens MOR, Schachter J, Sweet RL. Risk factors associated with pelvic inflammatory disease of differing microbial etiologies. *Obstet Gynecol.* 1994;83:989–997.
34. Hemsell DL, Nobles BJ, Heard MC, Hemsell PG. Upper and lower reproductive tract bacteria in 126 women with acute pelvic inflammatory disease. *J Reprod Med.* 1988;33:799–804.
35. Eshenbach DA. Epidemiology and diagnosis of acute pelvic inflammatory disease. *Obstet Gynecol.* 1980:55(suppl):142–152.

36. Chow JM, Yonekura L, Richwald GA, et al. The association between *Chlamydia trachomatis* and ectopic pregnancy. A matched case control study. *JAMA.* 1990; 263:3164–3167.
37. Sherman KJ, Daling JR, Stergachis A, et al. Sexually transmitted diseases and tubal pregnancy. *Sex Transm Dis.* 1990;17:115–121.
38. Marchbanks PA, Annegers JF, Coulam CB, Strathy JH, Kurland LT. Risk factors for ectopic pregnancy. A population based study. *JAMA.* 1988;259:1823–1827.
39. Miettinen A, Heinonen PK, Teisala K, et al. Serologic evidence of *Chlamydia trachomatis, Neisseria gonorrhea,* and *Mycoplasma hominis* in the etiology of tubal factor infertility and ectopic pregnancy. *Sex Transm Dis.* 1990;17:10–14.
40. Buehler JW, De Cock KM, Brunet J-B. Surveillance definitions for AIDS. *AIDS.* 1993;7(suppl 1):S73–S81.
41. Laara E, Day NE, Hakama M. Trends in mortality from cervical cancer in the Nordic countries: association with organized screening programmes. *Lancet.* 1987; 1:1247–1249.
42. Centers for Disease Control and Prevention. Chronic disease reports: deaths from cervical cancer—United States, 1984–1986. *MMWR Morb Mortal Wkly Rep.* 1989;38:650–659.
43. Kleinman JC, Kopstein A. Who is being screened for cervical cancer? *Am J Public Health.* 1981;71:73–76.
44. Atrash HK, Rowley D, Hogue CJR. Maternal and perinatal mortality. *Curr Opin Obstet Gynecol.* 1992;4:61–71.
45. Barber JB. Improving accuracy of death certificates. *J Natl Med Assoc.* 1992;84: 1007–1008. Editorial.
46. Hanzlik R. Improving accuracy of death certificates. *JAMA.* 1993;269:2850.
47. Jacobson L, Westrom L. Objectivized diagnosis of acute pelvic inflammatory disease. *Am J Obstet Gynecol.* 1969;105: 1088–1098.
48. Crews DE, Stamler J, Dyer A. Conditions other than underlying cause of death listed on death certificates provide additional useful information for epidemiologic research. *Epidemiology.* 1991;2:271–275.
49. Buehler JW, Berkelman RL, Stehr-Green J. The completeness of AIDS surveillance. *J Acquir Immune Defic Syndr.* 1992;5:257–264.
50. Selik RM, Chu SY, Buehler JW. HIV infection as leading cause of death among young adults in US cities and states. *JAMA.* 1993;269:2991–2994.